APRIL
1968

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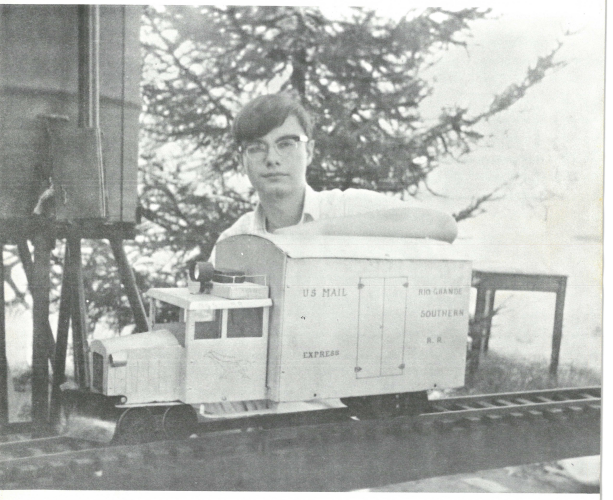
Live Steam



Build your own GALLOPIN' GOOSE

Live Steam magazine

APRIL 1968 VOL. 2 NO. 4.

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COVER PHOTO - Billy Cook and his Gallopin' Goose on the E.G.B. & Pacific tracks in Cincinnati. Photo by John Bardo.

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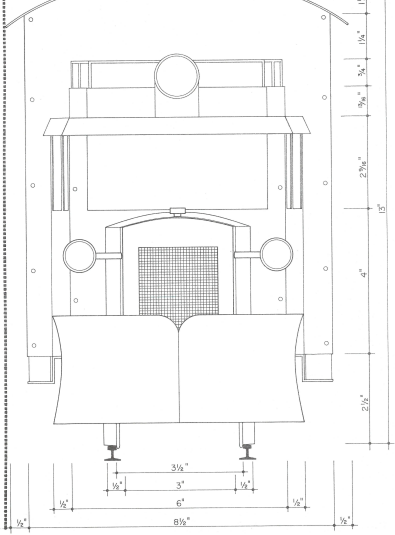
The story of a small

GALLOPIN' GOOSE



Gallopin' Goose

to start a 100-pound load. The gear ratio was selected and work started on the gear box. Billy used 48 pitch gears, simply because the scrap box made many of them available, and he did the layout and all the machining on the box with only adult supervision and instruction. Unfortunately, the designer (me) goofed, and all this work on the gear box went for naught, because upon completion of the box it was connected to the motor and only by using the lowest ratio would it give enough power to perform. It took 13 minutes to make a complete circuit of a 200' track. This was more like a "Dawdlin' Duck" than a "Gallopin' Goose!" Bill's hopes were almost dashed by this error, and it was certainly a shame to see his youthful enthusiasm slowly dying out.

I'm afraid I underestimated this youngster, but perhaps the decision to change the motive power to something having a little more muscle might have helped some. In the scrap collection box there was a six-volt starter motor taken from a 1923 Chevrolet. In reality, the "Geese" were partly old automobiles, so why not? At least, it did eliminate the necessity for gear boxes and such. Here for sure was electrical power that needed no great reduction for torque, so once again work was resumed.

The RPM output of the motor was reduced by the use of a 13- to a 17-tooth sprocket, and the size of the driving chain was ¼" pitch. The two rear axles are also coupled by a ¼" pitch chain and the front truck wheel is "blind" or flangeless. This was out of necessity as the rear truck is mounted rigidly to the frame and the front wheels of the truck must slide over the rails past the flange line. The small 2½" driving wheels provided a speed reduction as the series-wound motor winds up to a high RPM with light load. Electrical energy is provided by a Delco 100-ampere hour, six-volt battery, purchased at a low price from a junk dealer. Recharging is taken care of by a trickle charger donated by a friend, and it usually takes three or four days to recharge.

A big problem was the high amperage draw by the motor on starting - 80 amperes on initial start and dropping to 35 amperes for steady running. As the motor will give far too much speed if left to peak out with the usually light load, the motor is operated at about a 50% duty cycle. The speed control is simple as the power is either off or on. The power control switch is homemade, using 13 gauge copper plate as sliding contacts. It was found the motor was far too powerful for operation on six volts, so a tap was made on the battery to operate on four volts. This does have some slight advantage as it leaves one cell somewhat in reserve. In actual operation, a fairly easy start can be accomplished by quickly making and breaking the contacts to keep the wheels from spinning.

The wheels are steel, as are the truck side plates and axles. The axles and truck side plates are case hardened for wear, and the outboard bronze bearing on the drive shaft of the power truck was added to provide more support for the chain sprocket. The frame plate is of 13 gauge steel with a 1/8x1x1 angle iron forming the turned down edge. The young builder did not do the arc welding, as it was felt learning too many things at one time was not best. The cab and the freight space of the "Goose" were made from 20 gauge sheet metal, all parts cut to size, then bent to shape. The attachment together was with 3/32" soft iron rivets which is less messy than poor soldering, easier to do, and is far stronger. The headlights are brass tubing, the radiator is a piece of screen, the working headlight atop the cab is a small tin can, and there is a bicycle horn inside the cab. The painting and lettering, silver and black, in that order, are done as per the photograph of the full-sized machine, and with some adult supervision.

This railcar will handle two people on a 1½% grade, the battery provides enough power for about two hours operation, plenty for an afternoon of fun. The slow recharging rate of the rebuilt "junked" trickle charger is a disadvantage, however, for a small boy's pocketbook, the price was just right! From an adult Live Steam point of view, there might be some frowning on this type of rail vehicle; however, watching it being built - the age and the background of the builder, the learning of a small boy to do things with metal - all things considered, it was a wonderful experience for me to have had a part in helping create a small "Goose that Gallops."

Onto the trestle at Ophir.

Coventry Day at LALS

by W. ROSS CRAWFORD
Trainmaster LALS

GENE HACKLEY

Honored Guest H. J. Coventry looks over an 1½" scale model of the C&S #22 built by Bud Whitmer and now owned by LALS President, Tom Crawford. Shown above are (left to right) Tom Crawford, Morry Abowitz, Doug Alkire, Dick Priest, Mr. Coventry, Ross Crawford and Joe Nelson ... LALS Greeting Committee and Guest. Dick Priest's "Daylight" is in the background.

Occasionally, we in the steam fraternity, are afforded the opportunity to partially repay one of our "senior engineers" for their many contributions to the growth of our hobby.

On Sunday, February 18th, the Los Angeles Live Steamers observed *Coventry Day* to honor H. J. Coventry who recently celebrated his 81st birthday...and who, for 50 years, has written articles and furnished castings for Live Steam locomotives.

In 1927, Harry built ten ½" scale locomotives for the B&O Fair in Baltimore, including a Ross Winans Camelback and a "Tom Thumb," as well as five modern engines.

Coventry Day was blessed with beautiful weather (after two days of rain) and Dick Priest's "Daylight" and Tom Crawford's C&S #22 hauled passengers right "on the advertised."

All in all, Harry seemed to enjoy the day...and we sure enjoyed talking to him. Maybe now that he has moved from Baltimore to McAlester, Oklahoma, we will see him more often.

MAY

17 **PIONEER VALLEY LIVE STEAMERS**
18 Annual Spring Meet
19 3½"–4¾"–7½"
Brenton W. Barnfather, Secy.
3 Fleetwood Drive
Sandy Hook, Conn. 06482

25 **GOLDEN GATE LIVE STEAMERS**
26 Annual Spring Meet
2½"–3½"–4¾"–7½"
Ron Downer, Secy.
1274 36th Avenue
San Francisco, Calif. 94122

30 **PENNSYLVANIA LIVE STEAMERS**
31 Annual Spring Meet
1 2½"–3½"–4¾"
2 Frank H. Moore, Jr., Secy.
211 Walnut Avenue
Wayne, Pennsylvania 19087

30 **LOS ANGELES LIVE STEAMERS**
31 Annual Spring Meet
1 3½"–4¾"–7½"
2 W. Ross Crawford, Secy.
6900 Reyer Street
Canoga Park, Calif. 91304

JUNE

14 **NEW JERSEY LIVE STEAMERS**
15 Annual Spring Meet
16 3½"–4¾"–7½"
Ralph Green, Secy.
845 Kilsyth Road
Elizabeth, N. J. 07208

AUGUST

24 **GOLDEN GATE LIVE STEAMERS**
25 Annual Fall Meet
2½"–3½"–4¾"–7½"
Ron Downer, Secy.
1274 36th Avenue
San Francisco, Calif. 94122

31 **PENNSYLVANIA LIVE STEAMERS**
1 Annual Fall Meet
2 2½"–3½"–4¾"
Frank H. Moore, Jr., Secy.
211 Walnut Avenue
Wayne, Pennsylvania 19087

SEPTEMBER

20 **NEW JERSEY LIVE STEAMERS**
21 Annual Fall Meet
22 3½"–4¾"–7½"
Ralph Green, Secy.
845 Kilsyth Road
Elizabeth, N. J. 07208

OCTOBER

11 **PIONEER VALLEY LIVE STEAMERS**
12 Annual Fall Meet
13 3½"–4¾"–7½"
Brenton W. Barnfather, Secy.
3 Fleetwood Drive
Sandy Hook, Conn. 06482

REGULAR RUN DAYS

GOLDEN GATE LIVE STEAMERS
Every Sunday, weather permitting
2½"–3½"–4¾"–7½"
Ron Downer, Secretary
1274 36th Avenue
San Francisco, Calif. 94122

JAMUL VALLEY RAILROAD CLUB
3rd Sunday of each month
7½" gauge
Charles Underhill, Secretary
4675 Coronado Avenue
San Diego, Calif. 92107

LOS ANGELES LIVE STEAMERS
1st Saturday & Sunday each month
3½"–4½"–7½"
W. Ross Crawford, Secretary
6900 Reyer Street
Canoga Park, Calif. 91304

NEW JERSEY LIVE STEAMERS
1st & 3rd Sundays each month
3½"–4¾"–7½"
Ralph Green, Secretary
845 Kilsyth Road
Elizabeth, N. J. 07208

PENNSYLVANIA LIVE STEAMERS
2nd Sunday, May thru October
2½"–3½"–4¾"
Frank H. Moore, Jr., Secy.
211 Walnut Avenue
Wayne, Pennsylvania 19087

RIVERSIDE LIVE STEAMERS
4th Saturday & Sunday each month
7½" gauge
Merril Van Noty, Secretary
677 Flynn Street
Riverside, Calif. 92507

SOUTHERN CALIFORNIA LIVE STEAM CLUB
3rd Sunday each month
3½"–4¾"–7½"
K. G. Kepner, Secretary
2764 Magnolia
Rialto, California 92376

GREEN BOARD FOR OLD #3!

The Live Steamers in Winnipeg can be justly proud...the long months of preparation and anticipation have now produced results and Old #3 of the City of Winnipeg Hydro will continue to operate!

The lease has been completed for the engine and running rights have been obtained from the Canadian National on its Oak Point Line from St. James (in metropolitan Winnipeg) to Grosse Isle, Manitoba. It's a 17 mile run through rural country-side with slightly undulating grades and the first trip will be May 19th, 1968.

For schedule information contact:

Vintage Locomotive Society
% John LaPage
471 Waverly Street
Winnipeg 9, Manitoba, Canada

If you haven't already shared in the operation of this 1882 locomotive, don't forget to include your dollar for your Membership Certificate.

NEW LIVE STEAM CLUB IN TEXAS

President Paul L. DeVerter II of the Gulf Coast Chapter of the National Railway Historical Society announces that they have just received passenger coach #1141 from the Missouri Pacific Railroad and it is being moved to the Houston Union Station for use as their headquarters.

The good news does not stop there, however, for five members of that group have now decided to proceed with a Live Steam club track which will be run as a division of the Chapter!

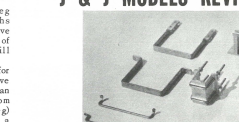
At the organizational meeting plans were made for 7½", 4½" and 3½" track, with the 4¼" and 3½" trestle-type construction to be tackled first. (A 3½" scale "Julie" is almost complete!) The new club would appreciate information on trestle construction, minimum radius and track height that other clubs could furnish.

A five-acre track site has been obtained in the southeast part of Houston and owner-lessor Bill Kercher is looking for a 7½" gauge engine.

Anyone interested in joining the Chapter is invited to attend the regular monthly meetings on the third Tuesday of each month in their coach #1141 at the Union Station in Houston. For further information contact:

Dennis Grigassy, Secretary
Gulf Coast Chapter - NRHS, Inc.
P. O. Box 9015
Houston, Texas 77011
Phone: MO 8–7317

J & J MODELS REVIVES LOST ART



The art of car building returned early last year with the announcement that J & J Models, 15712 South Condon Avenue in Lawndale, California 90260 would begin furnishing kits and parts for turn-of-the-century freight cars in 1½" scale. Their lost-wax castings and formed metal parts as well as 1¾" scale siding, flooring and millwork for car construction now make it possible to build freight cars with the same accuracy of detail as goes into motive power. A variety of queen posts for example, includes several styles which were used; stake pockets, steps, hinges for refrigerator car doors and many other finely-crafted parts are available. Their catalog (25¢) shows many additional parts as well as complete kits and built-up cars. Write them direct at the address above.

NEW PRODUCTS
NEW PRODUCTS
NEW PRODUCTS
NEW PRODUCTS
NEW PRODUCTS
NEW PRODUCTS
NEW PRODUCTS

1½" EQUIPMENT BRINGS AWARDS

PORTSMOUTH TIMES PHOTO

Readers of LIVE STEAM will quickly associate the address of Oliver T. Dotson, Jr. in Portsmouth, Ohio, with the ads for Buckeye Model Castings, for they are one and the same. Ollie's 1½" roller bearing trucks and his AAR couplers are to be seen on almost every club track.

For four years he has been working on an 1½" gondola which utilizes the parts he offers and last December it won for him the "Best Of Show" award in the 10th Annual Tri-State Model Railroad Show in Huntington, West Virginia. The awards included a permanent cup, a ribbon plaque and a revolving trophy.

Spring came early this year, and Ollie (who is a heavy equipment operator for a construction firm) is already involved in travelling extensively, and will continue to for the rest of the summer. This, of course, cuts deeply into the production schedule at Buckeye, but with the return of colder weather next fall he'll be back in the shop and foundry in back of his home where bigger and better things are in store for Live Steamers!

HOT AIR ENGINE WINS SCIENCE FAIR AWARD

THE HOT AIR ENGINE

by James Turner

Today most people think of the hot air engine as being an experimental source of mechanical energy devised by modern engineers. But this is completely wrong! The engine principle is old - over 150 years old. But, before going further, I would like to use the engine's proper name – Stirling Engine (or Stirling Cycle).

Robert Stirling was a Scottish minister coming from a long descent of engineers. When he and his brother constructed their huge engine in 1826, they knew why it worked, but couldn't explain the engine's function to the Scientific Association in London, England, so their theory remained known to few. Later in the century contributions were made by Sir George Cayne and John Ericcson.

To fully understand the anatomy of the hot air engine, this explanation is offered: The power piston (or working piston) runs approximately 90° behind the displacer at the crank. The working chamber is air-tight. One end of the displacer cylinder is heated by some source of heat and the other is cooled by fins. The loose fitting displacer (tight fitting in engines with a regenerator) is moved to the back or cool end of its cylinder, thus displacing the working fluid (or air) to the heated end. The air quickly heats and expands forcing the power piston outward. The displacer is then moved to the front or heated end of its cylinder displacing the air to the cool end. The cooling fins dissipate the heat into the surrounding air and the air within the engine quickly contracts making the piston back in. This cycle is repeated over and over again and with the help of a flywheel the engine runs smoothly in one direction.

Stirling cannot take all credit for the hot air engine, but he did add a device called the regenerator (or economizer). This bundle of metallic fibers simply removes heat from the air as it passes from the hot end to the cold end of the displacer cylinder and returns the heat when the air comes through again to the hot end, thus making the engine more efficient. To be called Stirling, the engine must correctly have a regenerator.

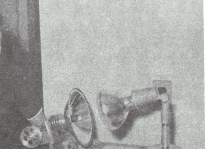
The hot air engine might have progressed into mass production if the scientists involved had used each other's designs.

Another Scotchman, John Ericcson made many contributions toward powering the engine by means of solar heat. He also constructed the first recorded solar-powered engine. The hot air engine was outnumbered by its former successor - the steam engine. Also, the coming of the internal combustion engine obscured the thought of a need for more efficient power. Around the 1940's, experiments showed the limited performance of the internal combustion engine. Research was again started on many different promising designs.

The N. U. Phillips Gloeilampen Labrieken of Eindhaven, Holland was investigating different means by which to power an electric generator for radio and home lighting. Somewhere the Stirling engine was dug up.

Phillips greatly improved the engine by using modern methods and materials. Phillip's first engine made its debut in 1944 and proved greatly successful with a 36% actual efficiency ranking over the 30% high of the best piston aircraft engine, the 34% high of the diesel, and the lacking 26% of the gas turbine.

The main improvement over the old prototypes was a change to a more efficient working fluid - being hydrogen or helium and the pressurization of the fluid within the working chamber. On the new engine, the internal pressure was 1,500 psi (2,100 lb. on expansion). Dead volume will lower efficiency considerably.



The accompanying article and the Stirling Engine shown in the photograph were both the work of Jim Turner who won a Second Place Award in his Junior High School Science Fair. Jim's Dad is Kenneth Turner, Jr., of the New Jersey Live Steamers and Jim's prowess with machinery may one day find its way to the NJLS track.

In 1960, Dr. T. Finkelstein of the University of Wisconsin designed a very efficient version of a solar-powered hot air engine which ran on a 24' parabolic mirror. A quartz window at the hot end of the displacer cylinder focused light as it passed through. Since quartz is a poor conductor of heat, the working chamber is given a greenhouse effect.

Optimum power is released by a simplified version essentially the same as the original Stirling engine except for the newly devised rhombic drive. This drive counteracts all gyroscopic effect and nearly completely dampens out vibrations. For these reasons, helium-filled engines equipped with solar reflectors are being favored over electric batteries for use in satellites.

Thermodynamic perfection in an engine is represented by the "reversed cycle." Imagine, if you put A units of heat into an engine and produce B units power in the crank - then if you put B units power in the crank you should produce A units heat if the engine is themodynamically perfect. Compare these statements with the imperfect steam engine.

Solar power for the Stirling engine is favorable in those zones where capital is too low for the purchase of petroleum fuels and/or if the forests are scarce.

I chose the solar-powered hot air engine for my Science Fair project because it best displays the independency of the hot air engine. Also, when the Fair is over, I will always have the engine left. I enjoy model-making my engine from plans in a recent Popular Science Magazine. Common parts were used such as steel conduit, ½" aluminum dural, foamglass, an old 7" auto reflector from a headlight. Construction was time-consuming (65 hours). Some of that time was wasted on parts that had to be made several times because of careless mistakes. After the engine had been constructed, a propane torch was used to test its performance.

From doing research on the Stirling engine, I am thoroughly convinced it has a promising future in industry, transportation and home utility.

THE BOILER: FEATURES AND DESIGN

SO YOU WANT TO BUILD A LIVE STEAM LOCOMOTIVE

CHAPTER 9

by Joseph F. Nelson

When the locomotive builder starts to think about the boiler for his locomotive he will have to make certain decisions as to the type. This is determined by the period the engine represents, the ability of the builder, the availability of special tools not in the builder's shop and the economic factors involved. Leaving all the other factors out it will be pretty much of a cut-and-dried proposition since most locomotives of any one period have pretty much the same characteristics and most of them can use a tube for a shell with any special contouring built up with insulation before the boiler jacket is installed. However, when a builder decides to build a locomotive with a true Belpaire Boiler by rolling his courses from flat sheet and then forming his firebox section, etc., he is letting himself in for some real problems if he is not skilled in the working of heavy gauge sheet metal nor has the necessary tools available. This writer is speaking from experience since he built one true K-4 boiler from steel tubing and flat sheet and the second one from flat copper sheet. The Belpaire boiler on his D-16 is dummy.

Another decision the builder has to make is whether the boiler should be (1) carbon steel with steel or copper tubes; (2) stainless steel with stainless tubes or copper tubes; or (3) full copper boiler. This is usually determined by economics; however, the general pattern is: large 1½" scale engines use steel boilers with steel or copper tubes and everything smaller uses copper boilers. The fabrication and engineering characteristics of stainless steel boilers will be discussed later. Brass boilers are successful in small sizes; however, the lead content in some free-machining brass tubing and sheet makes silver soldering slightly erratic. Castings of bronze are satisfactory although some porosity may exist which can be called to hold water at 300 PSIG hydrostatic test.

Whether to use superheater flues or a smokebox superheater has already been discussed in the chapter on the Smokebox but some additional points will be brought out to help the builder make a decision. Since staybolts, stay tubes and other forms of internal boiler bracing are safety items, their spacing to each other and their cross-sectional areas must be considered from a mathematical point of view. Incidentally, firebox staybolts do assist in radiating firebox heat into the boiler water.

BOILER DESIGN

The boiler barrel is a self-supporting surface; that is, it will stand any internal pressure up to rupture, without staybolts or bracing. For boiler barrel data, see Chapter Five, "ENGINEERING DATA." When a boiler barrel is rolled from flat sheet, however, and is riveted or welded together at a longitudinal joint, the stress on the joint is computed as follows: Boiler Pressure times half the internal diameter times the length of the joint. For problem purposes a joint length of 1" may be used:

110 psi steam pressure (assumed)
x 3.5 radius of boiler shell(assume 7"boiler barrel I.D.)
385 pounds per linear inch stress on a longitudinal joint at 110 PSIG.

Since the boiler barrel is stressed for a safety factor of six times, the joint must also have the same safety factor, i.e.: 3864 x 6 = 23184/Linear inch.

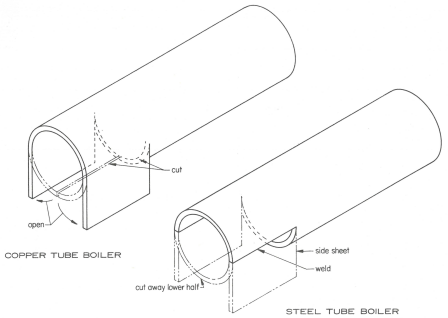
For a steel boiler barrel rolled from flat sheet and welded, it is natural to assume that most welds are not 100% of the strength of the sheet metal. However, by using high tensile strength welding rod and generous scarfing of the butting ends, a professional welder can make an electric or helarc weld that will produce a joint with a safety factor in excess of six.

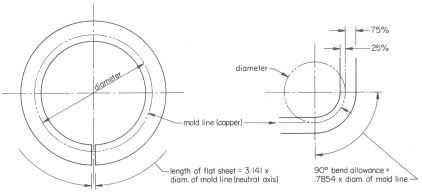
While it is not common practice to normalize small boilers after welding, it really should be done. Normalizing is a form of annealing to relieve strains adjacent to the welds whereby a welded assembly is brought up to a cherry red temperature and is then permitted to cool in still air. The metal in the weld during welding is molten and is much hotter than the adjacent metal with the result that the weld contracts more than the surrounding metal. This puts a strain on the metal next to the weld and if a failure does occur it is in the metal next to the weld and not the weld. This was discovered when locomotive boilers were first welded. Details of weld types used on Live Steam carbon steel and stainless steel boilers will be thoroughly covered in "STAINLESS STEEL BOILERS" later in this Chapter.

Incidentally, do not attempt to gas weld a steel or stainless steel boiler since the efficiency of the gas weld is very low and should never be used on pressure vessels. This does not apply to silver soldering or brazing. When riveting and silver soldering or welding boiler shell joints, the longitudinal joints are the most critical since they have the full steam pressure stress on them. The circumferential seams are less critical since the front end of the boiler (the front tube sheet which is mostly boiler tubes) is very well supported by the tubes and is also tied to the backhead by staybolts and stay tubes. Other surfaces are supported by staybolts and the strain on the joints is of little consequence. Don't cheat, however, on *any* joint!

Boilers are built as follows: (1) A responsible Live Steam Company may supply their standard boiler or fabricate a special boiler to your specifications. (2) Build your own boiler using seamless tubing, flat stock and purchasing whatever parts are available. (3) Build your own by forming boiler sheets from flat stock.

For 1" scale and smaller as well as some 1½" scale boilers, a length of copper tubing may be used for the boiler barrel. Cast bronze tube sheets, girder stays, backheads, etc., may be procured from various suppliers of Live Steam equipment and these castings will save a lot of work when fabricating a boiler. This method can also be used on Pennsy equipment since the fat Belpaire boiler can be built up with insulation and the Belpaire shoulders can be "dummy." There will be a minute difference in steaming but the difference would have to be measured in the laboratory and the outside would look just as genuine to the observer who would never know the difference unless he was told. Of course, plenty of people do ask whether the Pennsy engine boiler is a true Belpaire or not. The best thing is to tell the truth - this writer does when he is asked about his D-16A boiler




diameter
mold line (copper)
length of flat sheet = 3.141 x diam. of mold line (neutral axis)
75%
25%
diameter
90° bend allowance = .7854 x diam. of mold line

BEND ALLOWANCE

Refrigeration Solder	Rigid at	Flows above	Remarks
95-5 solder	450° F	465° F	95% tin, 5% antimony, no lead
Sta-clean flux	excellent for all soft solder jobs except electrical		
Silver Solder	**Starts**	**Free flow**	
Easy Flo 45	1125° F	1145° F	will not build up
Sil-Fos	1185° F	1300° F	can be built up, flux not required
Handy Flux	1100° F to	1600° F range	

which is dummy and his K-4s Belpaire boiler which is for real. The way out for the locomotive builder who hasn't the tools or the ability to form heavy gauge copper or steel (but still wants to build a Pennsy or some other locomotive with a highly contoured boiler) is to dummy the outline and let it go at that.

The seamless steel tubing boiler is built somewhat similar to the copper tube boiler with some exceptions: it is more of a problem to split the end of a steel tube and open it to where it will clear the firebox than to do the same job on a copper tube since steel doesn't work as easily as annealed copper. It is also easier to cut out the lower half of the steel tube over the firebox and weld in sheet steel sides. The forming of steel sheets can be kept to a minimum since they can be cut to size and shape and be welded in place. Copper sheets, however, must have their edges formed sufficiently to provide space for rivets and, after that, silver soldering.

Fabricating a carbon steel, stainless steel or copper boiler from sheet metal to prototype contour requires rolls and a press brake capable of handling heavy sheet metal. A problem usually arises when one attempts to have a large 1½" scale boiler made from flat sheet since the metal rolling and press braking is too heavy for the small shop and too small for the large shop. Most small shops, however, can handle 1/8" sheet metal or that is thick enough for any 1" scale boiler. Unless a prospective builder knows of a shop with suitable equipment, it would be better for him to forget contour and build or purchase a straight tube boiler which can then be contoured with insulation. The various companies which supply parts for Live Steam locomotives, can supply standard boilers for most of the common wheel arrangements. Also, in many cases, modifications can be made to their boilers if the customer is capable of and is willing to do the engineering and supply them with legible drawings of what is required.

When laying out copper sheets that require forming (flanges for riveting) make certain that enough flange is allowed to permit proper riveting. Also, when working any bend or radius, a bend allowance must be considered. Copper stretches 75% and compresses 25% while steel compression and stretch is even (50–50). If the bend allowance is not considered, the sheet metal worker will end up short and not know what happened. When figuring a bend or radius, consider the mold line and not the inside diameter.

When fabricating a copper boiler, it is first necessary at anneal all the copper sheets that require forming by hand. Secondary annealing may also be required during forming since bending or hammering will work-harden copper. Annealing copper and some other non-ferrous metals is accomplished by heating it red hot and then plunging it into cool water. Since copper has such high heat conductivity, care must be exercised in handling it while it is being heated or serious burns will result. Until it has been thoroughly quenched in cold water, handle it with pliers or tongs and don't try to give it a quick nudge with the bare hands.

When silver soldering a boiler, the whole boiler becomes annealed. This means that when computing stress on boiler metal and rivets, the tensile strength of annealed copper must be used; the exception being the use of silicon bronze screws for staybolts, when the root diameter of the annealed screw is used.

For copper rivets in shear, use the shear figure for annealed copper with a safety factor of about four, relying upon the silver soldered joint to bring the safety factor well above six. It must be realized that the staybolts carry the full load as do the stay tubes; therefore, even though the supported sheets have a certain stiffness and will carry part of the load, the ability of the supported sheets to carry some of the load must not enter into the computation of staybolt stress. Incidentally, due to high corrosion rate in steel boilers, it is advisable to stress staybolts and stay tubes to a factor of 10. Oversize staybolts certainly won't do any harm.

FORMING BLOCKS

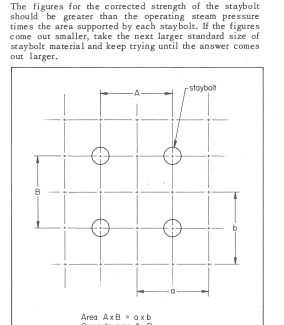
Forming blocks are used to form the riveting flange on copper boiler sheets and are made from hard maple. The forming is usually done in a heavy vise by beating the flanges over the edge of the block with a mallet. Care must be exercised when working the corners or external curves since the copper has to be compressed, while internal curves have to be stretched. In some cases, gripping the sheet between the block and the vise jaw will not be sufficient to prevent movement of the sheet. In this case it will be necessary to dowel the sheet to the block with flat head screws. The holes may be filled later with a screw and silver soldered over.

COMPUTING STAYBOLTS

To compute staybolts, find the area enclosed by four adjacent staybolts which will give the area supported by each staybolt on the same center-to-center dimension. Multiply this by the steam pressure which gives the actual strain on each staybolt. Take an arbitrary staybolt diameter, ¼" for example, and make a trial run.

Staybolt diam.^{2} x .7854 x Tensile strength of the metal
For Steel, ÷10 – For Copper or Silicon Bronze, ÷6

The figures for the corrected strength of the staybolt should be greater than the operating steam pressure times the area supported by each staybolt. If the figures come out smaller, take the next larger standard size of staybolt material and keep trying until the answer comes out larger.



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WATER TREATMENT

In answer to A. C. Otto's inquiry in the February issue: the usual "compound" methods of feed water treatment are satisfactory for large boilers where a selected solids concentration is maintained by blowdown systems. Blowdown is wasteful because of excessive water, fuel and treatment losses. Zeolite softening merely converts hardness to a soluble sodium form - solids still remain to cause priming. Rain water contains varying amounts of suspended solids and dissolved gases, particularly oxygen, which form scale, sludge and corrosion.

The best solution is a demineralization through an ion exchange column. These units remove all the mineral content leaving pure neutral water. Power Companies use deionized water to prevent silicate carryover with resultant coating of turbine blades. Deionizer cells are available on a rental basis through various suppliers and are well worth the cost.

V. F. KOHLER
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WOULD-LIKE-TO-SEE DEPARTMENT

After 47 years service as steam machinist on the Katy and the Missouri Pacific I enjoy reading LIVE STEAM Magazine. Sure did like that "Uncle Charlie," it is a fine looking job!

There are three valve gears that I would like to see written up in LIVE STEAM with some good sketches:

1. Young Valve Gear
2. Joy Valve Gear
3. Southern Valve Gear

Perhaps some of the readers can tell us about them.

GEORGE W. ROBB
RFD 1, BOX 64
SEDALIA, MO. 65301

BOILER LAWS

I have read with interest the remarks, on the subject of "the ancient boiler law" etc., in January LIVE STEAM.

First, let me say that I am a certified First Class Engineer in Alberta and Montana, and have operated, maintained, repaired, and inspected boilers of many types during the past thirty years. From what I have read, there seems to be a tendency to jump to a conclusion that "Boiler Law" is at fault and that all "Modelers" build perfect boilers. However, we know there are many who know nothing of strengths of materials, etc., and are unconcerned about the terrific power stored in steam even at low pressures.

That all pressure vessels, including "live steam model boilers" must be properly designed and carefully fabricated to be safe, is a definite fact.

Therefore, it is time we standardize model boiler design and to this end I suggest you contact the Chairman of the Sub-Committee on Firetube Boilers, A.S.M.E.,...New York, explaining what has come up and requesting assistance in establishing a minimum standard of construction for "Model Steam Boilers" for North America.

Having obtained this data, it follows that every boiler built to such approved design, of proper material and by certified pressure welders will be the safest we know how to construct.

I believe that if authorities can be shown that our fraternity is making every attempt to improve and upgrade the quality of "Model Boilers" to meet A.S.M.E. standards, we will have their respect and consideration.

Certainly, no "Live Steamers" should be discouraged since the proper approach will solve these problems.

R. J. HENRY
1138 24TH STREET SOUTH
LETHBRIDGE, ALBERTA, CANADA

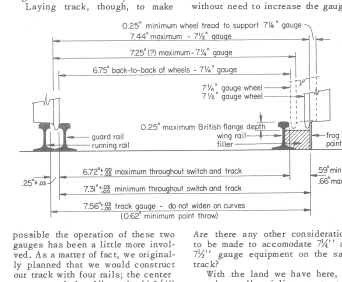
...from the cupola

While the situation was geographic originally, our position as publisher of LIVE STEAM Magazine now has also placed us literally in the middle of a condition that few have done anything about...and still fewer even seem to be willing to discuss! We're referring to the 7¼" - 7½" gauges for 1½" scale equipment.

To the east of us most of the track and equipment in this scale is built to 7¼" gauge while to the west of us it is 7½". Right here in the state of Michigan we have both gauges in operation.

The problem of building a Live Steam locomotive that could operate on both 7¼" and 7½" track has been pretty well worked out in sketch form and we try every chance we get to develop working drawings now to begin to make it a reality.

Laying track, though, to make


0.25" minimum wheel tread to support 7¼" gauge
7.44" maximum - 7½" gauge
7.25" (7) maximum - 7¼" gauge
6.75" back-to-back of wheels - 7¼" gauge
7¼" gauge wheel
7½" gauge wheel
0.25" maximum
guard rail
running rail
wing rail
filler
frog
point
6.72" +.03 -.00 maximum throughout switch and track
.59" min.
.66 max.
25° ±2
7.31" +.03 -.00 minimum throughout switch and track
7.56" +.03 -.00 track gauge - do not widen on curves
(0.62" minimum point throw)

possible the operation of these two gauges has been a little more involved. As a matter of fact, we originally planned that we would construct our track with four rails; the center two gauged for 1" scale (4-3/4" gauge) with two outer rails at 10" gauge so placed to permit 7¼" operation to one side and 7½" gauge to the other. This, of course, requires twice as much rail plus six frogs and four points for every switch, plus guard rails that would stagger the imagination.

One thing we are planning here at Wildwood Farm is an annual midsummer meet (as soon as we can put it into operation) where everyone can attend and run his engine. To this end we have discussed the track situation every chance we get and in a phone conversation with Gene Cranston of the Riverside Live Steamers a few weeks ago, we mentioned the subject. Lo, and behold, a letter from Gene a few days later brought out some very interesting possibilities and we pass them along to the "membership" with a request for comments and confirmation. Gene suggests that switches are the most difficult spot for dual operation, but submits the dimensions shown here for consideration. Please study them over and give us your comments. Neither of us had seen published standards for 7¼" gauge in this country, but Gene's data is taken from Greenly's "Model Railway Construction" and from the 7½" gauge standards compiled by Bob Harpur and Seymour Johnson.

Can you operate 7¼" gauge equipment without difficulty on 7½" track except for switches and other guard rail situations? Does "riding the flange" through a switch frog present any problem? Will a 7½" gauge 4-6-4 take a 100-foot radius curve without need to increase the gauge?

Are there any other considerations to be made to accomodate 7¼" and 7½" gauge equipment on the same track?

With the land we have here, we can keep all mainline curves to a minimum of 100 foot radius and more, if necessary, to eliminate need for widening the track gauge on curves where it might create a problem for operating 7¼" equipment. Reduced speed at switches might be necessary but all main line operation into the points of a switch could be arranged for straight-through operation with main line movement through the curved portion of the switch trailing the points.

So there it is for you to work on. As our son, Paul, once said: "With all the engineers and engine-uity in this hobby, they ought to be able to come up with some good solution!"

- W.C.F. -

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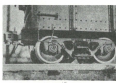

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